Hanford

Data

In[2]:=
```
index = {2.5, 2.6, 3.4, 1.3, 1.6, 3.8, 11.6, 6.4, 8.3};
deaths = {147, 130, 130, 114, 138, 162, 208, 178, 210};
```

In[4]:=
```
l1 = Sort[Transpose[{index, deaths}]];
```

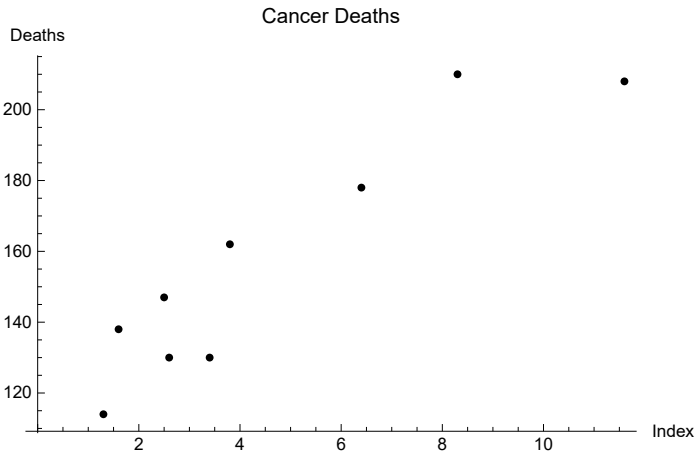
In[5]:=
```
Grid[Prepend[l1, {"index", "deaths"}], Dividers → All]
```

Out[5]=

index	deaths
1.3	114
1.6	138
2.5	147
2.6	130
3.4	130
3.8	162
6.4	178
8.3	210
11.6	208

In[6]:=
```
lp1 = ListPlot[l1, PlotLabel → "Cancer Deaths",
  AxesLabel → {"Index", "Deaths"}, PlotStyle → Black]
```

Out[6]=



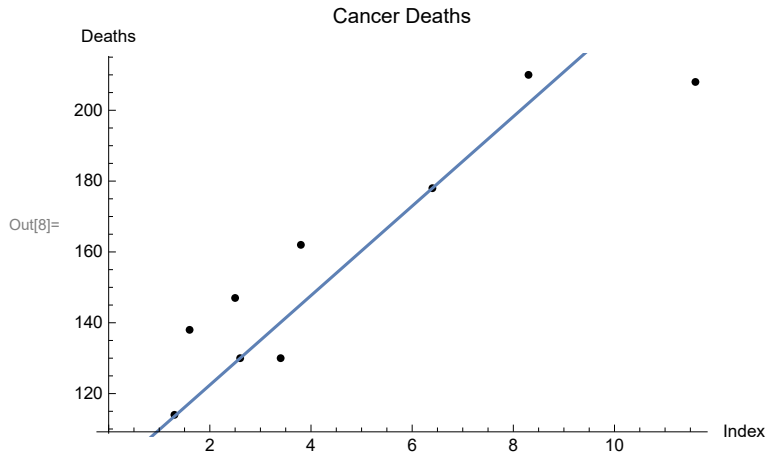
Lines of Fit

Two-Point

In[7]:=
```
twopoint[x_] := ((l1[[4]][[2]] - l1[[7]][[2]]) / (l1[[4]][[1]] - l1[[7]][[1]])) *
    (x - l1[[4]][[1]]) + l1[[4]][[2]];
```

In[8]:=
```
Show[lp1, Plot[twopoint[x], {x, 0, 12}]]
```

Out[8]=



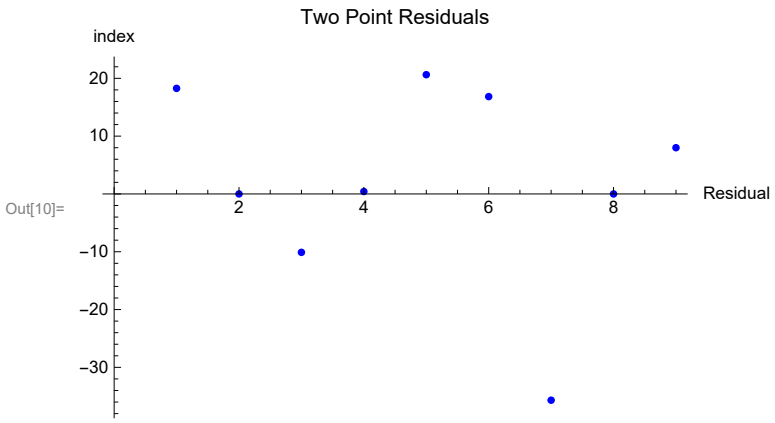
Residuals

In[9]:=
```
twopointres = Table[deaths[[i]] - twopoint[index[[i]]], {i, 1, 9}]
```

Out[9]=
```
{18.2632, 0., -10.1053, 0.421053, 20.6316, 16.8421, -35.6842, 0., 8.}
```

In[10]:=
```
twopointlp = ListPlot[twopointres, PlotLabel → "Two Point Residuals",
  AxesLabel → {"Residual", "index"}, PlotStyle → Blue]
```

Out[10]=



In[11]:=
```
twopointressum = Total[twopointres]
```

Out[11]=
```
18.3684
```

Median - Median

In[12]:=
```
median1x = Median[Sort[Table[l1[[i]][[1]], {i, 1, 3}]]];
```

In[13]:=
```
median1y = Median[Sort[Table[l1[[i]][[2]], {i, 1, 3}]]];
```

In[14]:=
```
median2x = Median[Sort[Table[l1[[i]][[1]], {i, 4, 6}]]];
```

In[15]:=
```
median2y = Median[Sort[Table[l1[[i]][[2]], {i, 4, 6}]]];
```

In[16]:=
```
median3x = Median[Sort[Table[l1[[i]][[1]], {i, 7, 9}]]];
```

In[17]:=
```
median3y = Median[Sort[Table[l1[[i]][[2]], {i, 7, 9}]]];
```

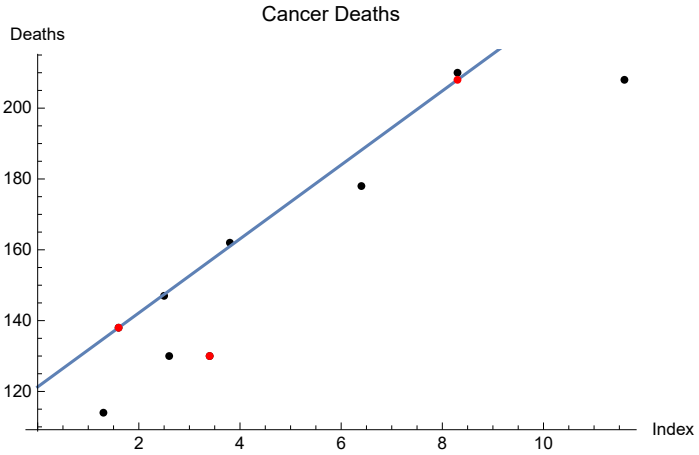
In[18]:=
```
line[x_] := ((median1y - median3y) / (median1x - median3x)) * (x - median1x) + median1y
```

In[19]:=
```
medianline = Plot[line[x], {x, 0, 12}];
```

In[20]:=
```
median = ListPlot[
   {{median1x, median1y}, {median2x, median2y}, {median3x, median3y}}, PlotStyle → Red];
```

In[21]:=
```
Show[lp1, medianline, median]
```

Out[21]=



Method 1: difference

In[22]:=
```
difference = line[median2x] - median2y
```

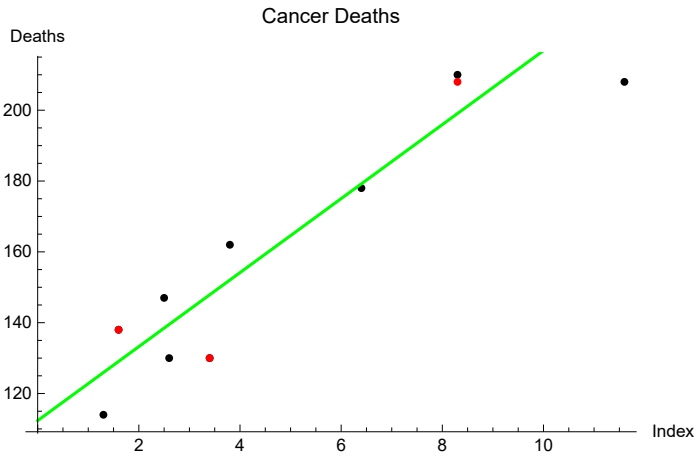
Out[22]=
```
26.806
```

In[23]:=
```
line2[x_] := line[x] - (difference / 3);
Expand[line2[x]]
```

Out[24]=
```
112.348 + 10.4478 x
```

In[25]:=
```
Show[lp1, Plot[line2[x], {x, 0, 12}, PlotStyle → Green], median]
```

Out[25]=



Method 2 : point slope

In[26]:=
```
b = line[0]
```
Out[26]= 121.284

In[27]:=
```
Clear[line2]
```

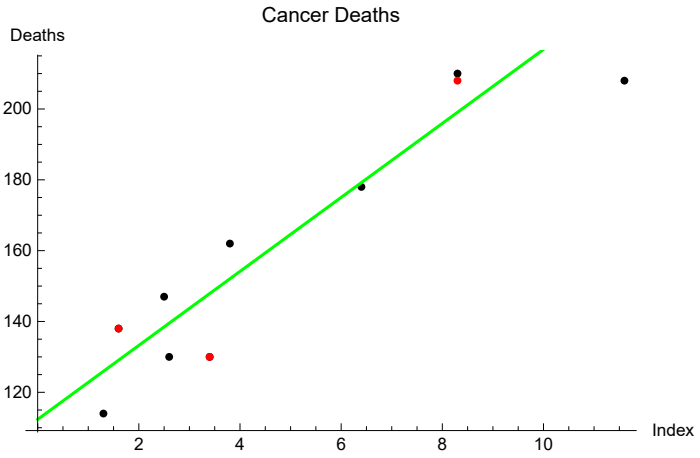
In[28]:=
```
line2[x_] := ((median1y - median3y) / (median1x - median3x)) * (x - median2x) + median2y;
```

In[29]:=
```
b2 = line2[0]
```
Out[29]= 94.4776

In[30]:=
```
line3[x_] = ((median1y - median3y) / (median1x - median3x)) * x + b - (b - b2) / 3;
```

In[31]:=
```
Expand[line3[x]]
```
Out[31]= 112.348 + 10.4478 x

In[32]:=
```
Show[lp1, Plot[line3[x], {x, 0, 12}, PlotStyle → Green], median]
```
Out[32]=

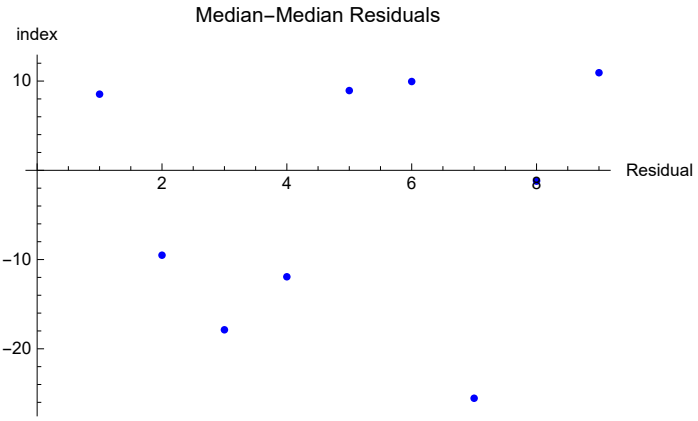


Residuals

In[33]:=
```
medianres = Table[deaths[[i]] - line3[index[[i]]], {i, 1, 9}]
```
Out[33]= {8.53234, -9.51244, -17.8706, -11.9303, 8.93532, 9.95025, -25.5423, -1.21393, 10.9353}

In[34]:=
```
medianlp = ListPlot[medianres, PlotLabel → "Median-Median Residuals",
  AxesLabel → {"Residual", "index"}, PlotStyle → Blue]
```

Out[34]=



In[35]:=
```
medianressum = Total[medianres]
```

Out[35]= −27.7164

Least Squares

In[36]:=
```
Clear[A, B, C1, D1, E1, m, b]
```

In[37]:=
```
n = 9;
```

In[38]:=
```
z1[m_, b_] := ∑_{i=1}^{n} l1[[i]][[2]] - (m * l1[[i]][[1]] + b);
```

In[39]:=
```
A = ∑_{i=1}^{n} l1[[i]][[2]]^2;
```

In[40]:=
```
B = ∑_{i=1}^{n} l1[[i]][[1]] * l1[[i]][[2]];
```

In[41]:=
```
C1 = ∑_{i=1}^{n} l1[[i]][[2]];
```

In[42]:=
```
D1 = ∑_{i=1}^{n} l1[[i]][[1]]^2;
```

In[43]:=
```
E1 = ∑_{i=1}^{n} l1[[i]][[1]];
```

In[44]:=
```
z2[m_, b_] := A - 2 * m * B - 2 * b * C1 + m^2 D1 + 2 * m * b * E1 + n * b^2;
```

In[45]:=
```
m = (B * n - C1 * E1) / (D1 * n - E1^2)
```

Out[45]= 9.27386

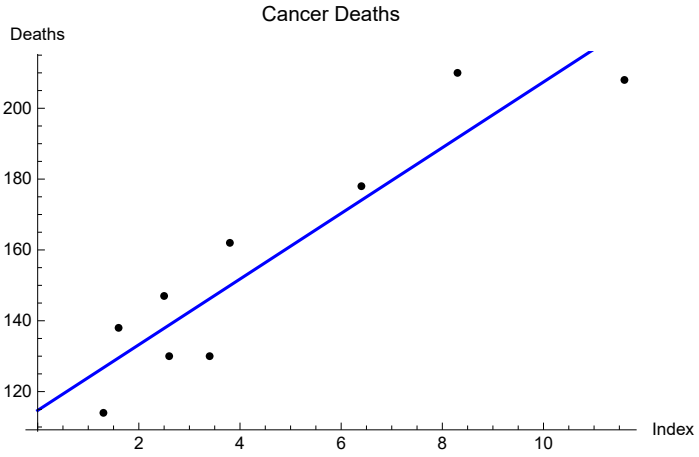
In[46]:=
```
b = (C1 * D1 - B * E1) / (D1 * n - E1^2)
```

Out[46]= 114.682

In[47]:=
```
leastsquares[x_] := m * x + b
```

In[48]:=
```
Show[lp1, Plot[leastsquares[x], {x, 0, 12}, PlotStyle → Blue]]
```

Out[48]=



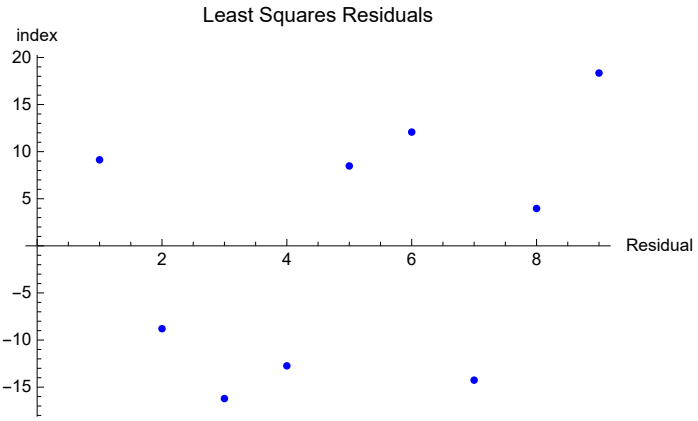
Residuals

In[49]:=
```
leastres = Table[deaths[[i]] - leastsquares[index[[i]]], {i, 1, 9}]
```

Out[49]=
```
{9.13371, -8.79367, -16.2128, -12.7376, 8.48019, 12.0777, -14.2585, 3.96564, 18.3453}
```

In[50]:=
```
leastlp = ListPlot[leastres, PlotLabel → "Least Squares Residuals",
  AxesLabel → {"Residual", "index"}, PlotStyle → Blue]
```

Out[50]=



In[51]:=
```
leastsum = Total[leastres]
```

Out[51]=
```
0.
```

Compare Residuals

In[52]:=
```
GraphicsRow[{twopointlp, medianlp, leastlp}, ImageSize → Full]
```

Out[52]=